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Foogle: Advanced Surveillance Technique to Find Missing Person with Face Search System

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ABSTRACT: Our Foogle system identifies the face to be searched, from the surveillance camera attached in various zones and recognizes them by comparing with the datasets and gives an alert along with the location to the searcher. The face to be searched can be a missing child or a criminal or a human trafficker or invisible friends or a missing person or a women trafficker. The system consists of one or more zones where certain number of surveillance cameras are installed in each zone. A person whose face is to be searched is uploaded in the web application as a dataset which consists of different orientations of the searched person. Once the face is uploaded, the given face will be searched in the streaming video of all the surveillance cameras and is detected and recognized by using Face Detection and Face Recognition Technology.

KEYWORDS: Face Detection, Face Recognition, Foogle, Missing Person, Surveillance Camera

I. INTRODUCTION

Children are the most important pillar of our future nation. Many children are reported as missing every year. Approximately, in India, an estimated amount of 96,000 children go missing each year. Among them large amount of children go untraced. Only a few are found and reunited with their parents. Crime rate and the number of criminals are also increasing each year. Among them only few criminals are arrested with an ease while others hide themselves. Our proposal using Face Recognition Technology for finding the missing child or missing person or women traffickers or human traffickers or criminals who escape from the police can be found using the surveillance camera installed in various public zones. Our Foogle search uses the Deep Learning technique which involves Face Detection and Face Recognition Technology. Deep Learning concept involves classification of the uploaded person's face and stores the face in the database and once the stored face is found in one of the surveillance camera's streaming video then the face is detected and then it is recognized by using Multi-Task Cascaded Convolution Networks (MTCCN) and FaceNet algorithm respectively. If the face in the database matches with the face in the surveillance video then an alert along with the location of the camera zone is sent as a notification to the person who registered.

This paper has 6 sections. Section 1 holds the Introduction, Section 2 holds the Related Works, Section 3 holds the System Architecture, Section 4 holds the experimentation and results, Section 5 holds the Conclusion and Section 6 holds the References.

II. RELATED WORKS

There are a wide collection of face detection and face recognition works out there. The following are the most related works of this system:KhaledAssaleh*et al.* [3] proposes a Face recognition system in different surveillance cameras using Discrete Cosine Transform (DCT), which extracts powerful features from an image for Face Recognition. Here the user's face image is cropped and eliminating the background, in order to extract the frontal face image only. DCT is applied to the features such as eyes, noses and mouth to recognize the faces. NurA'inJamil *et al*. [4] employs a system which recognizes the face in the surveillance camera videos using Pose Correction. This system will improves the

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representation of face by eliminating the effect of the captured non facial details such as occlusion, background, noise and produces a smooth image. Thus it improves the face recognition. The works of [5, 11] proposes a system that will use themodest AdaBoost algorithm. Thisalgorithm chooses the smallest number of extended Haar-like features. For Face Recognition, it uses the PCA (Principal Component Analysis) and Eigen faces approaches. A Face Recognition method [2] proposed by Ya Wang *et al.* for real world surveillance videos using deep learning. This method is of two parts. In the first part, the data from the real-world surveillance video is automatically collected and labeled to construct a dataset. In the second part, the constructed dataset is used to fine-tune the VGG (Visual Geometry Group) face recognition model. In order to eliminate the need for using a large dataset, UmmeAiman et al. [7] proposes a model of deep learning neural network that will learn from a smaller dataset. GailiYue*et al.* [8] employs a model where face recognition is done using Histogram equalization and Convolutional Neural Networks (CNN). Here the face images are preprocessed using the Histogram equalization and the preprocessed images are classified using CNN.

III. METHODOLOGY

A) SYSTEM ARCHITECTURE

The Foogle system consists of many public zones such as junction road, a street, main road, etc., Each zone has certain number of cameras depending upon the need. All the surveillance cameras in a particular zone are connected to a single Digital Video Recorder (DVR). DVR varies according to the number of channels capacity. Similarly, the other zone camera are connected to the corresponding DVR. The video streamed from all these cameras are maintained in the Foogle Interface. This Foogle interface is implemented in Web Application developed using Flask. Flask is a python micro web framework. The User Interface is created with a dataset connection, where the user can upload the missing child's face or missing person's or a criminal or trafficker's face.

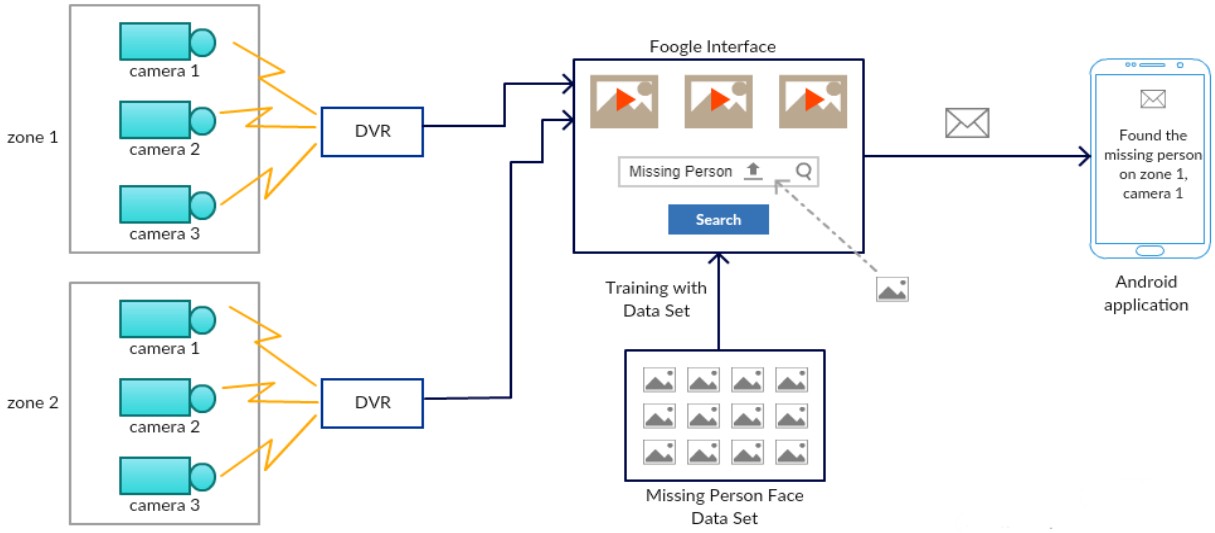

Fig -1: System Architecture of FOOGLE

The Foogle System is trained with the missing child's face or a missing person's face or a criminal's face or trafficker's face dataset, which contains the face images of the missing child or missing person or criminal face or a trafficker face. If the uploaded face in the dataset matches with any of the faces in the streaming videos of various zones an alert is sent along with location of camera and zone.

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B) MODULES

The Foogle System is divided into three modules. The modules are Embedding the Streaming Video, Face Detection and Face Recognition, Sending Alert Messages.

i) EMBEDDING THE STREAMING VIDEO

A live video stream from the surveillance camera is streamed in our web application using Real Time Streaming Protocol (RTSP). This protocol is designed for the Entertainment and Communication Systems. Since this is a network control protocol, it is used for controlling the streaming media servers. This protocol is used for establishing and controlling media sessionsbetween end points. The Real Time Streaming Protocol facilitates real time controlssuch as play, record and pauseof the media streaming from the server to a client and vice versa.

ii) FACE DETECTION AND FACE RECOGNITION
a) FACE DETECTION

In this section, faces are detected using Multi-Task Cascaded Neural Networks (MTCNN) algorithm. This algorithm can be used for training and testing. MTCNN algorithm involves three stages .The first stage it uses shallow Convolutional Neural Networks (CNN) and creates a number of windows on a single image. The second stage uses a little refinement which involves the inherent correlation by using complex CNN and removes the windows with non faces and in the third stage, a powerful refinement techniques are used which identifies the five positions of the face because of the cascading and refinement technique.

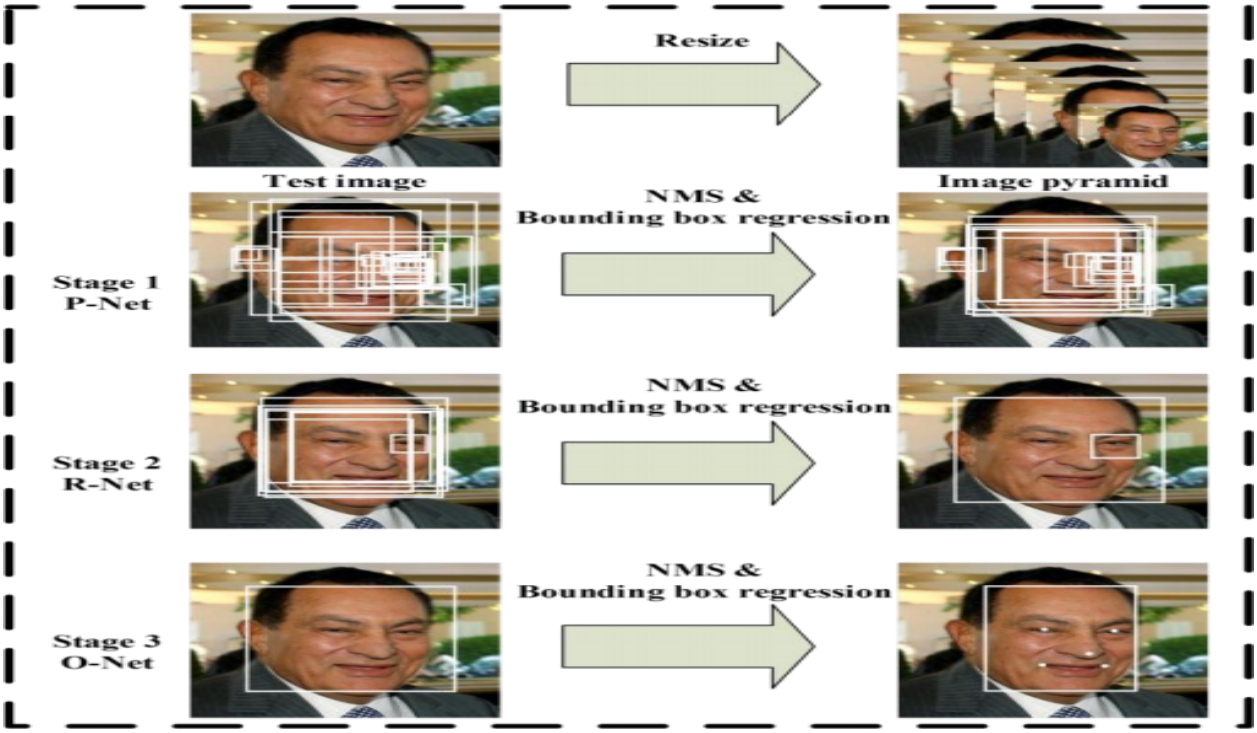

Fig -2: Three stages of MTCNN face detection algorithm (source: [12])

Three stages in the MTCNN face detection algorithm are:Proposal Network, Refine Network and Output Network.

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Proposal Network In this network, an image is resized to build an image pyramid which is then passed through the Convolutional Networks, called P-Net to get the bounding boxes on the facial window of the given image. A number of facial windows are bounded.

Refine Network In this network, the number of false facial window boundaries formed will be refined using a complex Convolutional Neural Network, called the R-Net.

Output Network In this network, correct face regions are identified with more supervision. As a result, five facial positions are identified at the end of this algorithm, called O-Net.

PSEUDOCODE FOR FACE DETECTION:

Input: original test image

Output: Image with face indicators as rectangle

Algorithm: MTCNN

1. Import OpenCV and MTCNN
2. Create detector of the MTCNN class
3. Call the detect_faces function of the detector & pass it to result variable
4. Print result
5. Pass the results to bounding_box and keypoints variable
6. Call the OpenCV rectangle function & pass the bounding_box as argument
7. Show the output image using OpenCVimshow function

Fig -3: Sample results of MTCNN face detection algorithm(source:https://www.pytorials.com)

b) FACE RECOGNITION

Facial Recognition is a powerful tool used by the law enforcement for tracing the criminals, in finding the missing child or person. They are not only used by the law enforcement but also by many organizations in managing the attendance. There are various applications that use face recognition technology in day-to-day life like unlocking the phones, helping the blind, biometric system, attendance management system. The algorithms used in these applications may vary. Among them we use FACENET algorithm which gives accurate results in recognizing the faces.

FaceNet algorithm is a deep learning convolutional neural network model. For each face uploaded in the web application, the FaceNet algorithm returns 128 dimensional embedding vector which prevents us from collecting a

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large amount of dataset for a single face image. The FaceNet model has to be trained initially with a Triplet Loss function for different face classes to calculate the similarities and the difference between the different faces. If the similarity is higher, then the faces are clustered effectively.

Fig -4: Triplet Loss Training (source: [6])

The distance between the anchor and the positive is less because of the similarity whereas the distance between the anchor and the negative are more because of the difference between them is higher.

PSEUDOCODE FOR FACE RECOGNITION:

Input: original test image

Output: Image with face indicators as rectangle with corresponding labels

Algorithm: FaceNet

Compiling the FaceNet network

1. Import OpenCV, Tensorflow, OS, NumPy, Keras
2. Initialize the network with RGB channel input shape
3. Define Triplet Loss function
4. Compile the Face Recognition model using Keras.

Preparing the Database

1. Call img_path_to_encodingfor converting the image data to an encoding of 128 float numbers.
2. Take the image path to the above called function & feed the image into the face recognition network

Recognizing a Face

1. Call a utility function called img_to_encoding and feeds the new image
2. Set the minimum distance to 100
3. Loop over the database dictionary's name & encodings
4. Return the minimum distance
5. If minimum distance > 0.52 then the image doesn't exist in the database
6. If minimum distance = 0.52 then image is recognized
7. Show the images with the corresponding labels

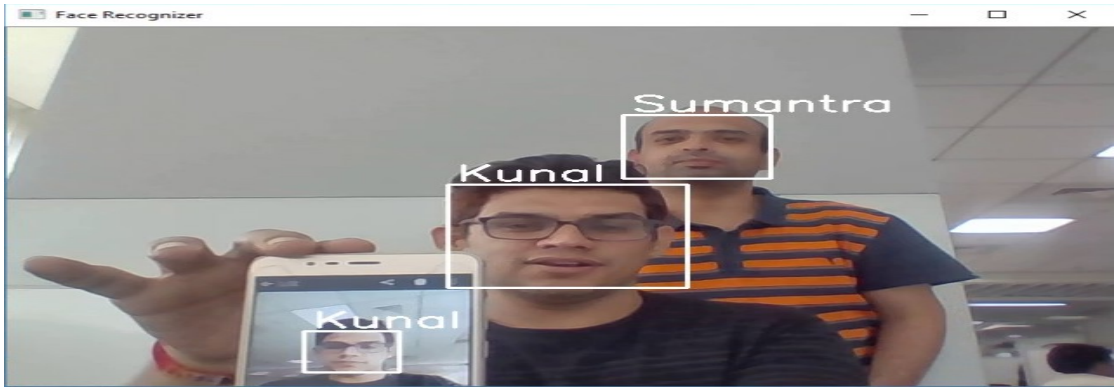

Fig-6: Sample result ofFaceNet-Face Recognition algorithm (source:https://medium.com@sumantrajoshi)

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iii) SENDING ALERT MESSAGES

Once the searched face is found in any of the surveillance cameras, an alert message will be sent to the user along with the location of the zone and the camera. This gives the information about the searched face along with the screen capture taken from the surveillance video. This message can be sent by using Text Magic API Python Wrapper. This API Includes all the built in commands that helps us to send bulk messages.

IV. EXPERIMENTATION AND RESULTS

This section describes our implementation of the above technology in an Automated Attendance Management Application.In Attendance Management System, a surveillance camera is placed in the classroom which captures the frame, detect the faces, then recognize them using the trained faces stored in the database and finally attendance is marked. Faces are detected and recognized using Multi-Task Cascaded Convolutional Neural Networks (MTCNN) framework and FaceNet Algorithm respectively. If the attendance is marked absent then an SMS alert is sent to the respective ward's parents. This type of attendance system is already used in many organizations but the limitation here is that students must come infront of the camera everytime. This consumes a lot of time. Our proposed system uses an algorithm which automates this method and gives an accurate result in recognizing the students faces. Finally after marking the attendance, the report about the performance of the students can be extracted when needed.

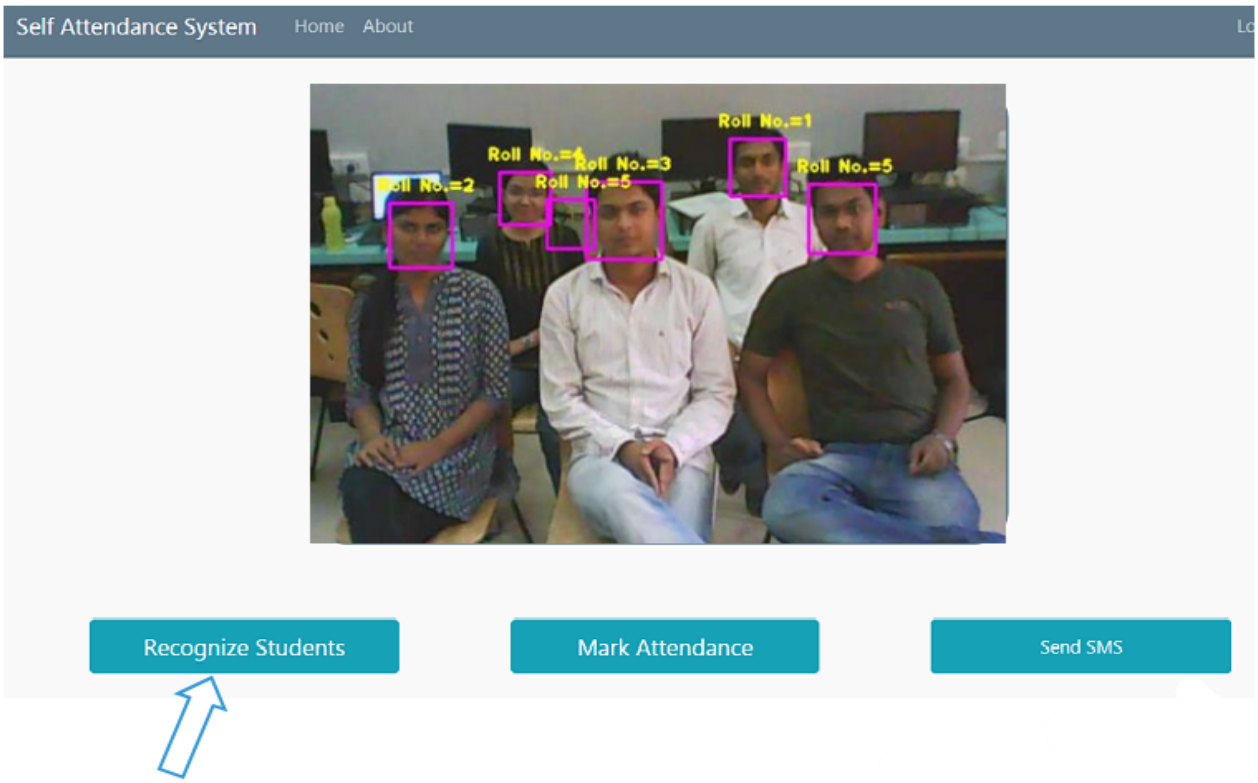

Fig -8: Real Time Face Recognition Module using FaceNet

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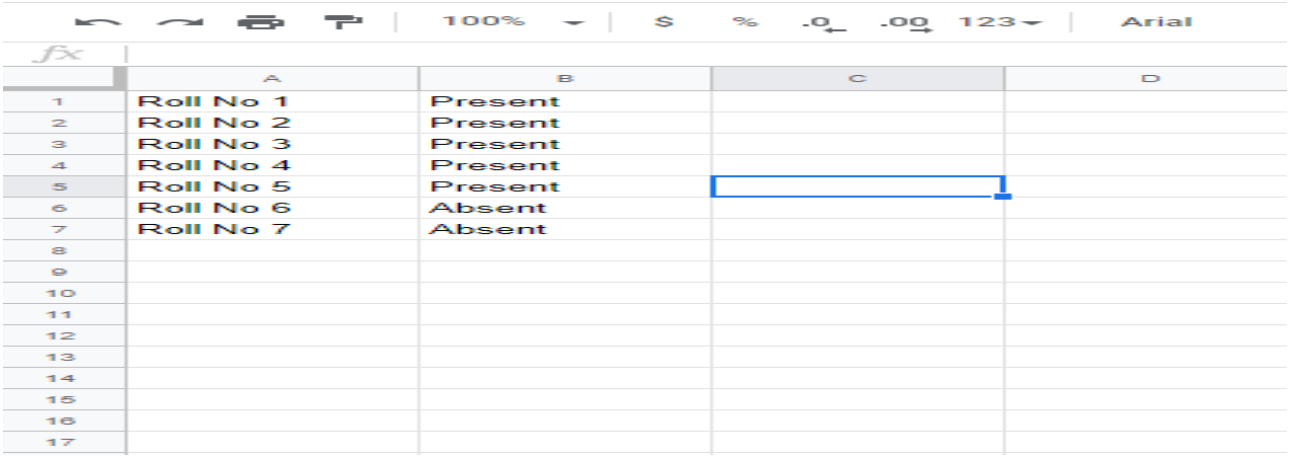

	A	B	C	D
1	Roll No 1	Present		
2	Roll No 2	Present		
3	Roll No 3	Present		
4	Roll No 4	Present		
5	Roll No 5	Present		
6	Roll No 6	Absent		
7	Roll No 7	Absent		
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				

Fig -9: Attendance Report Generated After the Face Recognition

Group	CNN	300 * Forward Propagation	Validation Accuracy
Group 1	12-NET P-NET	0.035s 0.031s	94.3% 94.5%
Group 2	24-NET R-NET	0.735s 0.458s	95.0% 95.5%
Group 3	48-NET O-NET	3.576s 1.347s	93.1% 95.5%

Table -1: Comparison of Speed and Validation accuracy of our CNNS and previous CNNS

V. CONCLUSION

In this paper, we have proposed a Foogle system for detecting and recognizing the missing child's face or missing person's face or trafficker's face or criminal's face using the surveillance camera videos by Multi-Task Cascaded Convolutional Neural Networks (MTCNN) framework and FaceNet algorithm. We have implemented the Foogle model in Attendance Monitoring System for automating the attendance system in various organizations & institutions.

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